VERIDIAN
Engineering Division
Transportation Sector

VERIDIAN RESPONSE TO NHTSA REQUEST FOR COMMENTS ON EVENT DATA RECORDERS

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1.0 INTRODUCTION:

Veridian Engineering is pleased to provide the National Highway Traffic Safety Administration (NHTSA) with responses to a Request for Comments regarding Event Data Recorders. The NHTSA Request for Comments was published in the Federal Register on October 11, 2000, and is listed as Docket Number NHTSA-02-13546; Notice 1, RIN 2127-AI72. This document presents the questions posed by NHTSA followed by the Veridian response.

2.0 SAFETY BENEFITS

2.1 NHTSA Question No. 1 - Safety Potential

The NHTSA EDR Working Group concluded in its August 2001 final report (section 11.1) that EDRs have the potential to improve highway safety greatly. Do you agree with this finding? What do you see as the most significant safety potential of EDRs?

Veridian Response:

Veridian concurs with the EDR Working Group's conclusion that EDRs have the potential to improve highway safety. The EDR is another tool for researchers and those involved in crash reconstruction that can provide valuable information on crashes. As the National Automotive Sampling System's General Estimates System (NASS GES) and Crashworthiness Data System (NASS CDS) have shown, as more data is available on crashes, actions can be initiated to address the problems and trends. The GES and CDS systems act as monitors, showing crash trends that require further investigation. EDRs offer the opportunity to enhance these databases, thereby allowing the government to focus on crash analysis within the vehicle population.

The most significant safety potential for EDRs is in the design of safer vehicles and to provide researchers with a growing database of high-quality data on crash events. A primary example of this potential is the use of EDR data in the reconstruction of the timing of the various safety devices in a vehicle. The recording of the initial use and position of the vehicle safety systems, such as seat belts prior to the crash, and then to monitor the functioning and relative timing of systems such as air bags (front and side) and seat belt pre-tensioners, can provide designers with feedback to improve their designs. Coupling this data with post-crash medical outcomes can enhance the usefulness of these systems.

2.2 NHTSA Question No. 2 - Application

EDR technology has potential safety applications for all classes of motor vehicles. Do you believe different types of EDRs should be used for different vehicle types, such as light duty vehicles, heavy trucks, intercity motor coaches, city transit buses and school buses? If so, why? If not, why not? Do you believe different types of EDRs should be used for different applications, such as private vehicles and commercial vehicles? If so, why? If not, why?

Veridian Response:

The vehicle population in the United States is very diverse, ranging from sub-compact, passenger automobiles to large commercial trucks. This diverse population of vehicles has

distinct sets of data requirements that should be recorded by an EDR. However, a core set of data may be applicable to the entire vehicle population. EDRs could be developed with variation that tailor a particular data set to a specific vehicle population. For example, an EDR for passenger vehicles may monitor seat belt use and seat belt pretensioner action for all applicable passengers during a crash. A commercial vehicle currently does not carry passengers or utilize pretensioner technology. In a similar note, transit buses do not have seat belts for passengers.

Commercial and private vehicles should all be equipped with EDRs. The inclusion of EDRs on all vehicles would facilitate a more accurate reconstruction of crashes. Data would be available from all vehicles involved in the crash. These EDR systems should have a core set of common data elements that would provide information that would be useful to vehicle designers to improve vehicle occupant protection. The EDRs would monitor vehicle parameters obtained from the engine, transmission and safety systems to determine that all systems were functioning properly at the time of the crash. Other data would be recorded based upon the presence of unique installed on each vehicle configuration. For example, the pneumatic brake systems used on commercial trucks.

2.3 NHTSA Question No. 3 - Use of EDR Data

NHTSA has used EDR data primarily to improve its investigations and analyses of crashes. In some cases, EDR data includes information that the agency could not otherwise obtain; e.g., which stage(s) of a multi-stage air bag deployed in a crash and when. In other cases, EDR data provide a more accurate indication of matters, e.g., level of crash severity, that have previously been estimated based on crash reconstruction programs. NHTSA includes the new or improved information from EDRs in its crash databases as appropriate. We request comments concerning how other parties, including government agencies, vehicle manufacturers, insurance companies, and researchers, are using these data. We also request comments concerning other potential uses of these data, by NHTSA and/or other parties, which are related to improving vehicle safety, either in the short term or long term.

Veridian Response:

Presently, vehicle manufacturers are using data from EDRs to monitor the functioning of safety systems such as air bags in real-world crashes. This data is beneficial in determining the adequacy of sensing systems and system performance. In government crash investigations, EDR data is used to help verify reconstruction of crashes. An example of this is the use of EDRs by the Special Crash Investigation (SCI) Teams funded by NHTSA. The data recorded by these systems can provide pre-crash vehicle travel speeds, and crash induced velocity changes.

The use of data from EDRs is expanding, as more vehicles are sold with these systems on-board. A number of potential uses have been mentioned in literature and other studies. One use could be to measure driver behavior by insurance companies. Insurance rates could be set depending on the driving habits of the individual driver. The medical community could use EDR data as an additional point of information in the treatment of crash victims. It should be noted that this concept was tested in the NHTSA/Veridian Automated Collision Notification Field Operational Test.

Data from EDRs can also be used in civil and personal litigation since EDRs will yield objective data as to what the vehicles were doing and how they were being operated at the time surrounding the crash. However, for this data to be completely useful, all vehicle involved in the crash should have an EDR to prevent a one-sided analysis of the crash event.

2.4 NHTSA Question No. 4 - Future Safety Benefits

What additional safety benefits are likely from continued development, installation, collection, storage, and use of EDRs?

Veridian Response:

As more vehicles equipped with EDRs enter the vehicle population a number of potential new safety benefits could be realized. These are provides and discussed below:

- *Increasing accuracy of accident reconstruction*
  Data derived from EDRs enhance the comprehensive reconstruction of a crash. The data cannot be used as a stand-alone source, but it adds reliability, confidence, and more data to the reconstruction.
- *Providing crash data to manufacturers for improved vehicle design*
  The crash data recorded by the EDR can be collected and maintained within a central database to provide sets of crash conditions that a vehicle must effectively protect passengers against. Currently this is done using vehicle crash testing in discrete crash conditions. The development of a database of crash pulses from a universe of potential crash configurations can assist the development of a more sophisticated occupant protection system.
- *Measure improvements in vehicle safety systems, vehicle designs*
  As more EDRs are deployed, a trend of crash type and injury severity will be established that can be tracked to observe trends in crashworthiness of various types of vehicles in various crash scenarios.
- *Improved injury mechanism determination*
  When linked with images of the crash scene and vehicle, the data from EDRs can be used by medical personnel to assess the potential for internal injuries to the vehicle occupants. This data can be used at the scene for emergency care, and can be used in the long-term to make mechanical/ergonomic design changes to the vehicle.
- *Improved highway design capability*
  Long term analysis and trending of EDR data could potentially indicate flaws in the design of certain highway locations. Conditions include excessive grade, improper crowning, roadway defects, improper speed limits, or improper turning radii could be determined.
- *In-field recording of normative driver behavior data*
  EDR's, if configured properly, could provide enormous amounts of data on normative driver behavior in crash events. This data could be very valuable in developing new or enhanced safety systems.

2.5 NHTSA Question No. 5 - Research Databases

NHTSA acquires EDR data in its Special Crash Investigations (SCI), National Automotive Sampling System Crashworthiness Data System (NASS–CDS), and Crash Injury Research and Engineering Network (CIREN) and incorporates them in its motor vehicle research databases. Have you ever used the EDR data stored in these databases? How could the presentation and/or use of EDR data be improved?

Veridian Response:

Veridian operates both NASS Zone Center 1 and an SCI team that routinely utilizes data from EDRs to reconstruct crashes. This data is a valuable tool to confirm the facts and quality of the reconstruction. The data could be made more useful if more types of data were available.

2.6 NHTSA Question No. 6 - Prevention of Crashes

Several researchers have documented that the use of EDRs could have the potential to prevent crashes. Some studies of European fleets found that driver and employee awareness of an on-board EDR reduced the number of crashes by 20 to 30 percent, lowered the severity of such crashes, and decreased the associated costs. (See section 2.5.1.1 of the August 2001 NHTSA EDR Working Group final report.) These studies have generally been based on small samples and concentrated on commercial application of EDRs. We request comments on other studies of this type and on this potential benefit from EDRs, particularly for the U.S. driving population.

Veridian Response:

Veridian is not aware of any long term, widely distributed investigation on changes in driver behavior with recording devices such as EDRs.

2.7 NHTSA Question No. 7 - Possible New Databases

As more and more vehicles are equipped with EDRs, more EDR crash data will be generated. Collection of these data is likely to increase as state and local officials collect these data as part of their investigations. Do you have any recommendations for storing and maintaining a national or other database? Do you believe maintaining a database would be beneficial to motor vehicle safety? Please provide specific examples.

Veridian Response:

Data collected from EDRs should be stored in a standardized national database. the NASS-CDS model, specifically is a good candidate for collection of this data. It has already started to collect this data, and provides an existing mechanism to collect (in-field PSU Teams), process (Zone Centers), and store (storage contractor), and access this data. However, NASS only samples approximately 5000 crashes per year, with only a small percentage these crashes are with vehicle equipped with EDRs.

This new database of crash data from EDRs could support the development of a national database of crash pulses and relevant vehicle and injury data that could be used to develop sets of crash conditions for vehicle occupant protection. Currently this testing is done using vehicle crash testing in discrete crash conditions such as barrier tests. The development of a database of

crash pulses from a universe of potential crash configurations can assist the development of a more sophisticated occupant protection system that could more effectively protect the occupants from a greater number of vehicle crashes.

2.8 NHTSA Question No. 8 - Standards

What standards exist for collecting EDR data? The Society of Automotive Engineers (SAE) has a recommended practice (SAE J211) that provides guidance for collecting crash test data. Would it be possible to use this or similar standards for collecting EDR data regarding real-world crashes? The Institute of Electrical and Electronics Engineers, Inc. (IEEE) has recently initiated a new program to develop a standard for motor vehicle EDRs. We request comments on the current activities of SAE, IEEE, and other standards organizations (U.S. and international) in developing standards for EDRs, and on what types of standards should be developed.

Veridian Response:

SAE J211 is a standard that specifies how acceleration data should be collected from standardized crash tests. The main theme of that standard can be examined and key aspects could be adapted for use in specifying some of the functionality of EDRs. Veridian is a participant in the IEEE P1616 Committee on Motor Vehicle Event Data Recorders (MVEDR). The goal of this committee is to publish a set of standards to identify the units, formatting of any potential data element that might be recorded in an EDR. This committee should not provide a minimum set of data elements for an EDR. The IEEE and SAE can be useful in developing standards for EDR characteristics including aspects such as data element definition standardization, system interfacing with the outside world, system survivability and environmental testing standards.

2.9 NHTSA Question No. 9 - Standardization

We request comments on whether there would be any safety benefits from standardizing certain aspects of EDRs, e.g., defining specific data elements such as vehicle speed, brake application, air bag deployment time, etc. Would such standardization promote further development and implementation of automatic crash notification systems or other safety devices?

Veridian Response:

The standardization of data elements would be beneficial to vehicle manufacturers and to crash reconstructionists alike because it would allow for the direct comparison of similar types of data across a wide cross section of vehicles and crash types. Defining data elements in a standard will ensure that the same sampling rates and physical representation of the data elements will occur and a direct “apples to apples” comparison can be made.

Standardization of EDRs should focus on areas such as crash and environmental survivability. To enhance the usefulness of EDRs, items as data connectors and data download protocols should be standardized across the industry.

3.0 TECHNICAL ISSUES

3.1 NHTSA Question No. 10 - Data Elements

The NHTSA EDR Working Group identified many data elements that could be collected by an EDR. See section 4 of the August 2001 final report. More recently, the Truck & Bus EDR Working Group generated a list of 28 data elements. See section 4 of the May 2002 final report. What data elements should be considered for inclusion in an EDR? Should they vary by vehicle type and/or application? Please provide a rationale for each element, with particular emphasis on how it would lead to improvements in safety. What costs are related to each of your proposed data elements?

Veridian Response:

See response to Question No. 2 for whether data elements should vary for vehicle type / application. A detailed dissertation of the specifically which data elements should be considered for inclusion in an EDR should be developed via research. Veridian is currently developing EDR specifications for heavy trucks in conjunction with the Federal Motor Carriers Safety Administration (FMCSA) and the Truck Manufacturers Association (TMA).

3.2 NHTSA Question No. 11 - Amount of data

Many late-model vehicles are equipped with OEM installed EDRs, but even among the vehicles of a given manufacturer, the type and amount of data collected vary. Do you have any recommendations for the amount of data to collect; e.g., how long before the crash occurs should the data be collected? How should the data integrity be maintained?

Veridian Response:

In order to reply to this question one must ask what is the goal of EDRs. If EDRs are to be used as a tool for providing manufacturers with data to allow them to design vehicles that protect the occupants better, an EDR that record only short (~100–300 msec), multiple crash event acceleration pulses would be reasonable. However, if one wants to use EDR data to monitor the behavior of the driver prior to a crash, or reconstruct crashes, a system with a predefined event trigger and a substantially longer record time is required.

Crash events are not all single impact events. A substantial proportion of crashes consist of multiple impacts. In order to capture these events one must use a predefined event trigger and pre-trigger value along with a substantial data acquisition time post-trigger time to capture the event. Veridian designed a system to record crash events for the Automated Collision Notification Field Operational Test (ACN FOT). This program used a trigger event consistent with a minor injury to the occupants. The ACN system utilized a pre-trigger value of two seconds and a post trigger recording duration of eight seconds. These values were sufficient to capture the crash events in the 39-plus crashes recorded in this program. It should be noted that in all of these cases the data was used to reconstruct the crash event. In order to capture the vast majority of multiple impact crash events, a fifteen second data acquisition time, with a five second pre-trigger, and ten second post-trigger could be used.

In order to maintain the integrity of the data, the data should be stored in non-volatile memory until downloaded.

3.3 NHTSA Question No. 12 - Storage and Collection

Currently, data are accessed by a physical connection to the EDR unit. Manufacturers are developing wireless connections, e.g., using a wireless probe near the crashed vehicle, or by having the on-board device upload the stored data to a central location using a telecommunications link, but such devices are not in widespread production. How should data be collected and stored in a motor vehicle? What measures should be in place to control traceability of EDR data to an actual vehicle or crash, such as EDR IDs or location and date stamping?

Veridian Response:

There does not appear to be sufficient justification to require wireless downloading of data from EDRs. Communication technology and wireless technology in particular, is advancing rapidly. For wireless communication of EDR data to be useful, it must use a protocol that can be supported for many years. In addition, to download data from a unit via wireless connection to the EDR would require that the EDR have a back-up power source, or be powered externally download the data. Any need to externally supply power to the unit would negate the advantage of wireless download. In addition, a wireless transfer of data could allow unwanted downloading of crash data by unauthorized personnel. Having one standardized connector that is used specifically to download EDR data and using one protocol that is universally employed for the transfer of EDR data to a portable computer (e.g. laptop PC) will allow for quick, efficient, and secure transfer of data from the vehicle to the crash investigator.

Data in the EDR should be recorded when a trigger is detected through the calculation of parameters such as change in velocity (□V), g-levels along specific vehicle axes, or deployment of the vehicle's safety restraint system. The data should be stored in non-volatile memory in a central, protected location. This will facilitate downloading of all vehicle data regardless of the in-vehicle data network. The EDR should have an on-board power supply sufficient to permit the completion writing crash data to memory even when vehicle power is cut during the crash event.

Traceability of EDR data can be maintained by programming the EDR at the factory with the Vehicle Identification Number (VIN). The VIN would then be placed in the header of the data steam of all recorded data. The VIN is routinely collected at all crash scenes, therefore providing traceability to a crash. Other header information could include data such as vehicle make, model, and year.

3.4 NHTSA Question No. 13 - Training

What training is needed for EDR data collection officials?

Veridian Response:

EDR data should be collected only by certified personnel. These personnel should be trained with sufficient skills in EDR operation, computer operation, and vehicle systems to permit them to locate the EDR and download the data. The data collection official should be trained with sufficient skill to interpret the data to perform a "first-level" quality assurance check on the data.

3.5 NHTSA Question No. 14 - Survivability

Recording and power systems need to withstand temperature and environmental effects, power failures, and the forces of different types and modes of crashes. They also need to be tamper proof. How can all these be accomplished? What needs to be done to ensure survivability of an EDR? What level of crash severity should an EDR be able to survive? What are the costs associated with producing an EDR with this level of crash survivability?

Veridian Response:

EDRs should be able to operate in a "standard automotive environment". There are SAE standards that describe temperature and environmental conditions and test standards for electronic equipment. The EDR should be able to pass these standards. In the event of a crash, the EDR should be capable of surviving crashes to ninety-five percent of the maximum change in velocity (□V) available in the NASS-CDS database. In addition NHTSA has published recommendations for survivability of EDRs for commercial vehicles. These recommendations can serve as an excellent starting point for a performance standard. An analysis can be made comparing the recommendations to actual crashes to determine the sensitivity of changing the survivability specifications and the loss of EDRs. For example, if EDRs did not have to survive submersion in water, how many EDRs would have been damaged in a typical year of crashes?

3.6 NHTSA Question No. 15 - Effect of EDR Technologies on Your Responses

Indicate how the nature of the EDRs currently being installed in motor vehicles affects your answers to the questions in this notice. To the extent that future EDR technologies are foreseeable, how would the implementation of those technologies affect your answers?

Veridian Response:

Veridian has extensive experience in the use and acquisition of data from current automotive EDRs. Veridian operates a team of investigators for NHTSA under the Special Crash Investigations (SCI) Program and NASS Zone Center 1. These investigators routinely acquire data from EDRs installed in crashed vehicles. This data is used in the reconstruction of these crashes. In addition, Veridian is operates the NASS Zone Center 1 for NHTSA. This program also has trained teams of investigators to acquire data from EDRs at crash scenes. The experiences our personnel have shaped our responses. In addition, previous work with Automated Collision Notification has provided us insight as to the issues of data elements, length of time to record, memory requirements, survivability and download of data.

4.0 PRIVACY ISSUES

4.1 NHTSA Question No. 16 - Privacy

What organizations are analyzing privacy issues in the context of roadways, vehicles, and vehicle owners? Are any additional types of analyses needed? Are privacy concerns adequately met by the current Federal and State law and practices relating to the collection and use of the information recorded by EDRs? Are there significant differences in privacy and/or liability law among states, in the circumstances under which persons or institutions other than vehicle owners may obtain that information, and the purposes for which those other persons or institutions may use that information? In what circumstances are police officers and crash investigators (from

government agencies or the private sector) allowed to access EDR data? What damages may result from inappropriate access to EDR data? What roles do technical solutions, such as data partitioning, encryption, and secure databases/vaults, play in addressing privacy concerns?

Veridian Response:

When Veridian investigators encounter a vehicle with an EDR, they try to acquire permission from the vehicle owner to download and publish the data. This process usually requires the investigator to inform the owner of the purpose of the government program, and then to assure them that this data can not be used against them. Even with this information, the owner will decline permission for the acquisition of the data.

Veridian believes that it is a good idea to encrypt EDR data and to require security codes to gain access to the data. This is necessary to prevent unauthorized downloading and use of the data. Current legal opinion on this subject indicates that the vehicle owner also owns the EDR data. As such, some effort should be made to protect the owner's rights

5.0 ROLE OF NHTSA

5.1 NHTSA Question No. 17 - Role of NHTSA

Over the past several years, NHTSA has been actively involved with EDRs, through the two working groups discussed above, as part of its crash investigations, and in research and development. Particularly since one working group has completed its work and the other is nearing completion, we request comments on what future role the agency should take related to the continued development and implementation of EDRs in motor vehicles.

Veridian Response:

NHTSA is the Department of Transportations' rulemaking body with regard to EDRs. In this role NHTSA may require EDRs. However, prior to exercising this power NHTSA should make all efforts to confirm the potential benefits of this technology. As a number of suggested steps, NHTSA could:

- Perform research on the need and cost/benefit for multiple EDR configurations for various vehicle configurations
- Encourage the development of standards on data elements and EDR operability, and
- Perform research to prove EDRs will successfully increase crash reconstruction results through:
  - Staged crash tests of varying complexity involving commonly occurring crash configurations,
  - Field Operational Tests including new configurations of EDRs,
  - Publish recommendations of EDR configurations,
  - Acquire feedback from Original Equipment Manufacturers, Tier 1 suppliers, the public
  - Develop an implementation plan for EDRs

6.0 VERIDIAN POINT OF CONTACT

The Veridian point of contact for further information on the material presented in this response is:

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